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U S DEPARTMENT OF COMMERCE PATENT AND TRADEMARK OFFICE

TRANSMITTAL LETTER TO THE UNITED STATES DESIGNATED/ELECTED OFFICE (DO/EO/US) CONCERNING A FILING UNDER 35 U.S.C. 371

ATTORNEY'S DOCKET NUMBER: 449122009000

U.S. APPLICATION NO (If known, see 37 CFR 1.5): 09/914848 Not yet Assigned

INTERNATIONAL APPLICATION NO.	INTERNATIONAL FILING DATE	PRIORITY DATE CLAIMED
PCT/DE00/00619	1 March 2000	4 March 1999

SEP 04 2001 PATENT & TRADEMARK OFFICE

TITLE OF INVENTION

DATA TRANSMISSION METHOD AND SYSTEM IN A MOTOR VEHICLE OCCUPANT PROTECTION SYSTEM (AS AMENDED)

APPLICANT(S) FOR DO/EO/US

Marten SWART et al.

Applicant herewith submits to the United States Designated/Elected Office (DO/EO/US) the following items and other information:

1. ☒ This is a **FIRST** submission of items concerning a filing under 35 U.S.C. 371.
2. ☐ This is a **SECOND** or **SUBSEQUENT** submission of items concerning a filing under 35 U.S.C. 371.
3. ☐ This is an express request to begin national examination procedures (35 U.S.C. 371(f)). The submission must include items (5), (6), (9) and (21) indicated below.
4. ☒ The US has been elected by the expiration of 19 months from the priority date (PCT Article 31)
5. ☒ A copy of the International Application as filed (35 U.S.C. 371(c)(2))
   a. ☒ is attached hereto (required only if not communicated by the International Bureau).
   b. ☒ has been communicated by the International Bureau.
   c. ☐ is not required, as the application was filed in the United States Receiving Office (RO/US).
6. ☒ An English language translation of the International Application under PCT Article 19 (35 U.S.C. 371(c)(2)).
   a. ☒ is attached hereto.
   b. ☐ has been previously submitted under 35 U.S.C. 154(d)(4).
7. ☒ Amendments to the claims of the International Application under PCT Article 19 (35 U.S.C. 371(c)(3))
   a. ☐ are attached hereto (required only if not communicated by the International Bureau).
   b. ☒ have been communicated by the International Bureau.
   c. ☐ have not been made; however, the time limit for making such amendments has NOT expired
   d. ☐ have not been made and will not be made.
8. ☐ An English language translation of the amendments to the claims under PCT Article 19 (35 U.S.C. 371(c)(3)).
9. ☒ An oath or declaration of the inventor(s) (35 U.S.C. 371(c)(4)).
10. ☐ An English language translation of the annexes to the International Preliminary Examination Report under PCT Article 36 (35 U.S C. 371(c)(5)).

Items 11. to 16. below concern document(s) or information included:

11. ☒ An Information Disclosure Statement under 37 CFR 1.97 and 1.98.
12. ☒ An assignment document for recording. A separate cover sheet in compliance with 37 CFR 3.28 and 3.31 is included.
13. ☒ A FIRST preliminary amendment.
14. ☐ A SECOND or SUBSEQUENT preliminary amendment.
15. ☐ A substitute specification.
16. ☐ A change of power of attorney and/or address letter.
17. ☐ A computer-readable form of the sequence listing in accordance with PCT Rule 13ter.2 and 35 U S C. 1 821 - 1.825
18. ☐ A second copy of the published international application under 35 U S.C. 154(d)(4).
19. ☐ A second copy of the English language translation of the international application under 35 U.S.C. 154(d)(4).
20. ☒ Other items or information: 1. IPER 2. Intl Search Report 3. Application Data Sheet 4. Return receipt postcard

CERTIFICATE OF HAND DELIVERY

I hereby certify that this correspondence is being hand filed with the United States Patent and Trademark Office in Washington, D.C. on September 4, 2001

LaVerne Whetstone

dc-278127

U.S. APPLICATION NO (if known, see 37 CFR 1.5) Not yet Assigned 09/914848	INTERNATIONAL APPLICATION NO PCT/DE00/00619	ATTORNEY'S DOCKET NUMBER 449122009000

21. ☒ The following fees are submitted:

BASIC NATIONAL FEE (37 CFR 1.492(a)(1)-(5)):

Neither international preliminary examination fee (37 CFR 1.482) nor international search fee (37 CFR 1.445(a)(2)) paid to USPTO and International Search Report not prepared by the EPO or JPO.....$1,000.00

International preliminary examination fee (37 CFR 1.482) not paid to USPTO but International Search Report prepared by the EPO or JPO.....$860.00

International preliminary examination fee (37 CFR 1.482) not paid to USPTO but international search fee (37 CFR 1.445(a)(2)) paid to USPTO.....$710.00

International preliminary examination fee (37 CFR 1.482) paid to USPTO but all claims did not satisfy provision of PCT Article 33(1)-(4) $690.00

International preliminary examination fee (37 CFR 1.482) paid to USPTO and all claims satisfied provisions of PCT Article 33(1)-(4) $100.00

	CALCULATIONS PTO USE ONLY	
ENTER APPROPRIATE BASIC FEE AMOUNT =	$860.00	
☐ Surcharge of **$130.00** for furnishing the oath or declaration later than ☐ 20 ☐ 30 months from the earliest claimed priority date (37 CFR 1.492(e)).	$0	

CLAIMS	NUMBER FILED	NUMBER EXTRA	RATE		
Total claims	11 - 20 =	0	x $18.00	$0	
Independent claims	3 - 3 =	0	x $80.00	$0	
MULTIPLE DEPENDENT CLAIM(S) (if applicable)			+ $270.00	$0	

TOTAL OF ABOVE CALCULATIONS =	$860.00	
☐ Applicant claims small entity status. See 37 CFR 1.27. The fees indicated above are reduced by ½.	$0	
SUBTOTAL =	$860.00	
Processing fee of **$130.00** for furnishing the English translation later than ☐ 20 ☐ 30 months from the earliest claimed priority date (37 CFR 1.492(f)). +	$0	
TOTAL NATIONAL FEE =	$860.00	
Fee for recording the enclosed assignment (37 CFR 1.21(h)). The assignment must be accompanied by an appropriate cover sheet (37 CFR 3.28, 3.31). **$40.00 per property** +	$40.00	
TOTAL FEES ENCLOSED =	$900.00	
Amount to be refunded:		**$**
charged:		**$**

a. ☒ Please charge my **Deposit Account No. 03-1952** in the amount of $ 900.00 to cover the above fees. A duplicate copy of this sheet is enclosed.

b. ☒ The Commissioner is hereby authorized to charge any additional fees that may be required, or credit any overpayment to **Deposit Account No. 03-1952**. A duplicate copy of this sheet is enclosed.

NOTE: Where an appropriate time limit under 37 CFR 1.494 or 1.495 has not been met, a petition to revive (37 CFR 1.137(a) or (b)) must be filed and granted to restore the application to pending status.

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Application Data Sheet

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Application Information

Title Line One:	DATA TRANSMISSION METHOD AND SYSTEM IN A
Title Line Two:	MOTOR VEHICLE OCCUPANT PROTECTION SYSTEM
Total Drawing Sheets:	1
Formal Drawings?:	
Application Type:	Utility
Docket Number:	449122009000

Representative Information

Representative Customer Number: 25227

Continuity Information

This application is a: 371 of
> Application One: PCT/DE00/00619
Filing Date: March 1, 2000

Prior Foreign Applications

Foreign Application One: 199 09 535.3
Filing Date: March 4, 1999
Country: Germany
Priority Claimed: yes

PATENT
Docket No. 449122009000

CERTIFICATE OF HAND DELIVERY

I hereby certify that this correspondence is being hand filed with the United States Patent and Trademark Office in Washington, D.C. on September 4, 2001.

LaVerne Whetstone

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In the application of:

Marten SWART

Serial No.: Not yet Assigned

Filing Date: September 4, 2001

For: DATA TRANSMISSION METHOD AND SYSTEM IN A MOTOR VEHICLE OCCUPANT PROTECTION SYSTEM

Examiner: Not yet Assigned

Group Art Unit: Not yet Assigned

PRELIMINARY AMENDMENT

Commissioner for Patents
Washington, D.C. 20231

Sir:

Prior to examination on the merits, please amend this application as follows:

In the Specification:

Page 1 before the first paragraph, please delete the following:

~~Description~~

The title as been amended as follows:

DATA TRANSMISSION METHOD AND SYSTEM IN A MOTOR VEHICLE OCCUPANT PROTECTION SYSTEM

On page 1, between lines 8 and 9 please insert the following:

CLAIM FOR PRIORITY

This application claims priority to International Application No. PCT/DE00/00619 which was published in the German language on September 8, 2000.

TECHNICAL FIELD OF THE INVENTION

Please replace the paragraph beginning on line 6 of page 1 with the following rewritten paragraph:

The invention relates to a data transmission method and system, and in particular, to a data transmission method and system in a motor vehicle occupant protection system.

On page 1, between lines 8 and 9 please insert the following:

BACKGROUND OF THE INVENTION

Please replace the paragraph beginning on line 9 of page 1 with the following rewritten paragraph:

EP 0 507 581 A1 discloses a data transmission system in which multiplex nodes are connected to a common bus line. In order to update the system, the multiplex nodes can transmit

specific protocol words which comprise a data segment specifying a multiplex node group, and a confirmation signal segment. During the confirmation signal segment, each addressed multiplex node which is associated with the selected group can emit a confirmation signal. If all of the addressed multiplex nodes reply with a confirmation signal, the protocol word is repeated twice, for example. If some of the addressed multiplex nodes have still not replied, the nodes which do not reply are excluded from the registration list which lists the active nodes. If, on the other hand, a node which has not been active until then should reply for the first time, the registration list is supplemented with this node which replies for the first time.

Please replace the paragraph beginning on line 28 of page 1 with the following rewritten paragraph:

With such a configuration, the known transmission collision problem, in which two or more nodes try to transmit at essentially the same time, may occur. In order to solve this problem, a priority sequence for the transmission authorization has to be predefined in each node, the priority sequence blocking transmission access to nodes with lower priority for as long as nodes with higher priority are transmitting. Therefore, before each bus access each node checks whether a node with a higher priority is not already transmitting, which can lead to a certain delay in the transmission of signals. In addition, a change in the fixed priority sequence is also problematic because the change has to be registered selectively in the multiplex nodes. In addition, synchronization problems may occur if the aim is to synchronize the timing clock of the operation of the individual multiplex nodes. In such a case, additional synchronization is necessary.

On page 1, between lines 10 and 11 has been amended to include the following:

SUMMARY OF THE INVENTION

In one embodiment of the invention, there is a method of data transmission, comprising: transmitting an interrogation signal in a polling mode from a superordinate control unit to

function units via a data bus, and transmitting a confirmation signal by the function units which are functioning and do not have any information to send, and when a confirmation signal is not received from a function unit, the superordinate control unit outputs a command signal which addresses the function unit and selectively causes it to transmit data.

In one aspect of the invention, the interrogation signal is transmitted cyclically.

In another aspect of the invention, the function units comprise impact and/or vehicle occupant detection sensors of a motor vehicle occupant protection system.

In still another aspect of the invention, the function units comprise firing caps for firing vehicle occupant protection means of a motor vehicle occupant protection system.

In yet another aspect of the invention, the interrogation signal comprises first signal segment for transmitting a polling command and a second signal segment which adjoins the second signal segment and which includes a multiplicity of regular voltage pulses which alternate between high and low potential.

In another aspect of the invention, the function units transmit confirmation signals in the form of current pulses during low level phases of voltage pulses of the signal segment.

In yet another aspect of the invention, the command signal has the same structure as the interrogation signal, and an address signal segment is provided instead of the signal segment which predefines the polling mode.

In still another aspect of the invention, an addressed function unit transmits its information in the form of current pulses during low level phases of voltage pulses of the command signal which adjoin the address segment, and generate check bits which are transmitted to the superordinate control unit after the transmission of information during further low-level phases of the command signal.

In another embodiment of the invention, there is a superordinate control unit; and a plurality of function units which are connected to the control/unit via a common data bus, in which the superordinate control unit is configured to repeatedly transmit an interrogation signal to the function units via the data bus, the interrogation signal requesting the function units to

acknowledge the confirmation signal, and when the confirmation signal of one of the plurality of function units is not received, the control unit outputs a command signal which addresses the function unit and which requests it to transmit an information signal to the control unit.

In another aspect of the invention, the function units have voltage regulators which are connected to the data bus on the input side and which generate the supply voltage for the respective function unit from the interrogation signals and command signals.

In still another embodiment of the invention, there is a superordinate control unit; and a plurality of function units which are connected to the control unit via a common data bus and in which an interrogation signal is transmitted in a polling mode from the superordinate control unit to the plurality of function units via the data bus, and a confirmation signal is transmitted by the function units which are functioning correctly and do not have any information to send, and when a confirmation signal is not received from one of the plurality of function units, the superordinate control unit outputs a command signal which addresses the function unit and selectively causes it to transmit data.

BRIEF DESCRIPTION OF THE DRAWINGS

The invention is described in more detail below by means of an exemplary embodiment and with reference to the drawings, in which:

Fig. 1 shows a schematic block circuit diagram of an exemplary embodiment of the data transmission system.

Fig. 2 shows the structure of the data words used for communication between the master and slave units.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

Paragraph beginning on line 12 of page 2 has been amended as follows:

The invention provides a data transmission method which permits efficient data transmission without collision problems.

Please delete lines 16 and 17 of page 2.

Please replace the paragraph beginning on line 19 of page 2 with the following rewritten paragraph:

The invention also discloses a data transmission system which is distinguished by efficient, collision-free transmission of data.

Please delete lines 24 and 25 of page 2.

Please replace the paragraph beginning on line 27 of page 2 with the following rewritten paragraph:

In the invention, the master/slave principle is used, the superordinate control unit performing the master function and exercising complete control of the data traffic on the data bus. Function units which are connected to the data bus are operated as slaves and interrogated repeatedly, preferably cyclically, in the polling mode. Function units which operate satisfactorily, and which do not emit any message, reply to each polling interrogation with a confirmation signal. If, however, the confirmation signal is not received from one or more function units, the superordinate control unit can address the function unit(s) in a targeted and selective fashion and provide them with the possibility of transmitting a respective message. This ensures that relatively rapid data transmission can take place without the risk of any collision problems. If a selectively addressed function unit does not transmit a message, this is an indication of a functional fault. Hence, the superordinate control unit can generate a corresponding fault message for rapid fault clearance, for example in the form of a visual or audible indication to the system user and/or in the form of a data entry in an operating

monitoring protocol. Thus, not only is the data flow on the data bus selectively controlled in each case by the invention so that no collision problems occur, but a diagnostic function is also achieved at the same time.

Please replace the paragraph beginning on line 19 of page 3 with the following rewritten paragraph:

When the invention is used in a motor vehicle, in particular a motor vehicle occupant protection system, the function units may be, for example, impact sensors or vehicle occupant detection sensors (seat occupation sensors). The function units can also alternatively or additionally be firing caps for firing vehicle occupant protection means or any other desired components. In each case, a multiple access of the function units to the data bus, and thus a possibility of a collision with a delayed transmission of signaling signals (for example sensor signals or sensor states) is avoided. The superordinate control unit determines the communications in each case. If the control system is a centralized one, the central control unit forms the superordinate control unit. In a decentralized system it is also possible for there to be a plurality of superordinate control units (masters) which each have selectively permanently assigned function units (slaves). In each case, a very rapid transmission of data is ensured.

Please replace the paragraph beginning on line 1 of page 4 with the following rewritten paragraph:

The superordinate control unit can itself determine the priority sequence with which function units which do not reply during the polling mode are interrogated, and if appropriate also change the priority sequence at any time, for example as a function of the results of the seat occupation detection. In order to define priorities, and if appropriate change them, there is no need for intervention in the subordinate function units so that the priority sequence can be defined very rapidly and without additional data communication via the data bus. In addition, during the polling mode the subordinate function units (slaves) have to continuously actively

reply. That is, they emit an OK message. The bus architecture is thus very well suited for a system with active function elements, in particular sensors.

Please replace the paragraph beginning on line 18 of page 4 with the following rewritten paragraph:

In addition to the transmission of information, the supply energy can also be transmitted from the superordinate control unit to the function unit via the bus by virtue of the fact that the transmission protocol, i.e., the exchange of data between the master and the slaves, preferably operates in a bipolar fashion, i.e. changes between 0 and 1. In addition, the cyclical polling interrogation also continuously transmits a clock frequency so that the entire bus system can operate synchronously. In particular if there is a phase change at each bit of the polling command, the average value of the signal does not necessarily change during the data transmission so that energy can be made available continuously.

Please replace the paragraph beginning on line 34 of page 4 with the following rewritten paragraph:

The function units preferably reply in their time window with current pulses, i.e., by appropriately loading the data bus with current so that the average value of the voltage is not varied, and at the same time the OK state is nevertheless reliably signaled to the superordinate control unit.

Please replace the paragraph beginning on line 1 of page 5 with the following rewritten paragraph:

The function units consequently do not require any separate clock. If they nevertheless have separate a clock generating device, this can be triggered and synchronized by the "1" bits transmitted by the superordinate control unit. In addition, the supply of energy to the function units for their operation is even, which is also ensured by the sequence of "1" bits provided in the polling command.

Please replace the paragraph beginning on line 10 of page 5 with the following rewritten paragraph:

The invention can be used in a sensor bus or a firing bus for vehicle occupant protection systems, or in any other desired bus system. In the two first-mentioned cases, the superordinate control unit is formed, for example, by a central airbag control unit which continuously maintains control over all the sensors and/or firing caps.

Please delete lines 18-20 of page 5.

Please delete lines 22-28 of page 5.

Please delete lines 26-28 of page 5.

Please replace the paragraph beginning on line 30 of page 5 with the following rewritten paragraph:

In the data transmission system shown in Fig. 1, there is a superordinate control unit 3 which is embodied as a central control unit and which controls the communication as a master unit. The control unit 3 is connected via a common data bus 1 to functions units 2, 4, 5 and 6 which are embodied as sensors. The function units can, however, also be firing caps or other control components or can be composed of a combination of sensors and firing caps or other elements. The data bus 1 is preferably embodied as a two-wire line and is used not only for

transmitting data but also for supplying energy to the function units 2, 4, 5 and 6. The data bus can additionally also serve as a control bus, that is to say transmit control instructions.

Please replace the paragraph beginning on line 10 of page 6 with the following rewritten paragraph:

The exemplary embodiment shown is embodied as a data transmission system of a motor vehicle occupant protection system in which the sensor 2 is used as a seat occupation sensor which detects whether the front passenger seat and/or the rear seats of the motor vehicle are actually occupied. A separate seat occupation sensor 2 is provided for each monitored seat. Because the seat occupation state generally does not change during the travel mode, the seat occupation state is interrogated at the start of the travel mode, and possibly at large time intervals, so that the frequency of sensor interrogations can be very low. Instead of seat occupation sensors 2, it is also possible to provide vehicle occupant detection sensors which are based on some other principle and which can detect the presence of passengers on the front passenger seat and/or the rear seats of the motor vehicle. This is used for suppressing the triggering of vehicle occupant protection device of seats which are not occupied, for example of airbags or seat belt pretensioning systems.

Please replace the paragraph beginning on line 32 of page 6 with the following rewritten paragraph:

The sensors 4 to 6 are impact sensors for detecting an impact and the location of its action, and if appropriate the direction of its action. The sensors 4 to 6 are arranged in a known fashion at a central point on the motor vehicle and at the front, rear and/or sides of the motor vehicle, the number of sensors being variable depending on the design specifications. The sensors comprise the slave units of the superordinate control unit (master) 3.

Please replace the paragraph beginning on line 4 of page 7 with the following rewritten paragraph:

Fig. 2 illustrates the structure of the data words 7 which are repeatedly emitted by the central control unit 3. These data words 7 are output quasi-permanently, at least during the travel mode of the motor vehicle after the minimum speed has been exceeded in order to trigger the vehicle occupant protection system when there is an accident. That is, the data words 7 are repeated cyclically in a fault-free situation without or with a short time interval. The data word 7 is a unipolar voltage signal whose voltage states change between a higher and a lower voltage value. This ensures that a voltage continues to be applied to the transmission line so that acknowledgement in the form of current pulses, for example by a simple impedance loading, is possible. According to Fig. 2, the data word is present in the form of a biphase code in which a "one" is signaled by phase change in the center of a bit, whereas a "0" is represented by a phase change at the end of a bit. The data word 7 is a 16-bit signal. The bit numbers are plotted on the bit axis illustrated underneath the data word 7.

Please replace the paragraph beginning on line 27 of page 7 with the following rewritten paragraph:

Each data word 7 comprises the signal segments 8 to 11 shown in Fig. 2. The signal segment 8 is composed of two start bits, which signal the start of the data word and are represented by two zeros. This is followed by the signal segment 9 in which either a specific command, in particular a polling command, or an address of a function unit which is to be addressed, in particular of a sensor 2, 4, 5 or 6, is transmitted. The signal segment 9 here comprises the bits 3 to 6 of the data word. During the following signal segments 10 and 11 (bits 7 to 16) the control unit 3 transmits a sequence of logic "1" in the polling mode (in this case the polling command is predefined in the signal segment 9) so that a signal level change from "H" to "L" occurs in the center of each bit 7 to 16. The second half of each bit 7 to 16 therefore has a relatively low voltage level. During this low voltage level, the sensors which are connected to the

data bus 1 can transmit back their OK messages to the control unit 3 in the form of current-modulated pulses, the current modulation being caused by the data bus being loaded by the respectively transmitting sensor. For example, a sensor, i.e., the communications device provided in it, can connect a load resistor to the data bus 1 during the low level phase of the bit assigned to it from the data word 7 so that current loading of the data bus 1, detectable by the control unit 3 (master), is brought about. This current loading pulse comprises the "OK" message of the respective sensor. Each slave unit (2, 4, 5, 6) is selectively assigned a fixed bit during the polling mode, during which it can emit its status message, for example the bit "7" for the sensor 4, the bit "8" for the sensor 5, etc. Consequently, the data word 7 illustrated can be used to address slave units (bits 7 to 16) during the polling mode 10. The respective bits 7 to 16 of the data word 7 thus define the respective addresses of the slave units in the polling mode. If there are fewer slave units than bits present in the signal segments 10 and 11, two or more bits for making acknowledgments can be made available to one, more or if appropriate even all the slave units so that they can emit more detailed acknowledgements, for example "OK", "urgent message", "normal message" and the like. One or more of these bits can then serve in each case as a checkbit/checkbits for the acknowledgement.

Please replace the paragraph beginning on line 1 of page 9 with the following rewritten paragraph:

During the polling mode, the slave units therefore reply actively in their time window (by means of a current pulse) and as a result signal their satisfactory state (no internal function faults, no impact, there is no other message to emit). However, if a slave unit is faulty or wishes to transmit a message to the master unit in a targeted fashion, the slave unit signals this to the master unit by failing to emit a loading pulse during the bit assigned to it during the polling mode. The master unit 3 detects this absence of an acknowledgement from the slave unit and changes from the polling mode to selective addressing of the slave unit which does not reply. In this case, the address which is assigned to the slave unit which does not reply is then transmitted

in the next data word 7 in the signal segment 9 instead of a polling command. Because the other slave units are neither addressed by means of a polling command nor by means of their own address, they remain silent, i.e., they do not transmit any information during the signal segments 10 and 11. The master unit 7 generates the signal segment 10 which adjoins the address 9, so that the profile shown in Fig. 2 is also obtained. However, the bits 7 to 12 (low level phases) are then available for the addressed slave unit so that the latter can transmit a multibit message to the master unit. The slave unit can, for example, transmit a data word, a measuring level or status information which signals, for example, a crash has been detected (for example an acceleration limiting value has been exceeded, or the strength of the measured acceleration).

Please replace the paragraph beginning on line 35 of page 9 with the following rewritten paragraph:

A slave unit can therefore very quickly emit its sensor information without collision problems by virtue of the fact that it merely fails to transmit an OK message during the next polling command and is then selectively addressed by the master unit which then fails to generate a polling command but instead generates the corresponding address in the signal segment 9 of the next data word 7, after which it can transmit its information in the form of a multibit word.

Please replace the paragraph beginning on line 8 of page 10 with the following rewritten paragraph:

However, if the selectively addressed slave unit does not make available any reasonable information during the bits 7 to 12, this is classified by the master unit as an operational fault of the slave unit (no "OK" message during a polling command, no evaluable information during the selective addressing of the slave unit). Such a slave unit which is detected as faulty can be gated out during the following polling mode, i.e., is not checked once more after each polling command. A status enquiry or communication then takes place with the other slave units.

Please replace the paragraph beginning on line 21 of page 10 with the following rewritten paragraph:

This transmission authorization control avoids a situation in which a plurality of slave units can access the bus simultaneously, with the result that there is no risk of a collision. At the same time there is the advantage that the master unit does not have to receive any asynchronously transmitted slave signals so that it is possible to dispense with interrupt handling routines which are otherwise necessary. The master unit is aware in each case of those times at which the (preferably current-modulated) slave signals are to be expected.

Please replace the paragraph beginning on line 33 of page 10 with the following rewritten paragraph:

Furthermore, it is advantageous that the slave units do not require their own clock because they can be clocked by the clock of the master unit. If the slave units nevertheless have their own clock generating device, this can be triggered and/or synchronized at any time by the "ones" transmitted by the master unit. The clock frequency is continuously transmitted by the master unit on the basis of the data word forming device 7, and can thus bring about the synchronization of the entire bus system.

Please replace the paragraph beginning on line 6 of page 11 with the following rewritten paragraph:

If the address of a single slave unit is transmitted in the signal segment 9, the bits in the signal segment 11 (bits 13 to 16) are used to transmit checkbits, for example a fault detection and/or correction code, for example CRC4. The master unit itself does not generate a separate error check code in this case but rather generates the bits of the signal segment 11 with the profile shown in Fig. 2, that is to say in an identical way to the transmission of a polling command. However, the addressed slave unit is programmed in such a way that it carries out, for

example according to the CRC method, a fault detection routine by its own address and also the information which is generated by it and is to be transmitted to the master unit in the low level phases of the signal segment 10. The fault detection word and/or fault correction word formed is transmitted to the master unit in the low level phases of the signal segment 11. The master unit checks the checkbits received in the signal segment 11, taking into account the slave address (in the signal segment 9) generated by it and the slave information (in the low level phases of the signal segment 10) received by it, and on the basis of the fault check which is known and used in the slave unit. If, for example, the checksum formed differs from the checksum transmitted by the slave unit, this indicates a fault either in the transmission or in the connected slave unit. In the event of the detection of a fault, suitable fault clearance routines can be carried out, for example transmitting the selectively addressed data word 7 once more from the master unit to the data bus 1 in order to cause the addressed slave unit to generate signals once more.

Please replace the paragraph beginning on line 1 of page 12 with the following rewritten paragraph:

During the polling interrogation, a situation may also occur in which two or more slave units do not reply with their response signal (current pulse in the assigned bit) because they want, for example, to transmit simultaneously or are connected to the bus in a faulty way, or not at all. In such a case, the master unit can define in what sequence it interrogates the non-replying slave units, on the basis of a priority sequence which is stored in it or generated. The priority sequence can be variable as a function of further parameters, for example the seat condition status. Because only the master unit includes and defines the priority sequence, a priority change can be carried out without difficulty and extremely rapidly. If, for example, two side impact sensors on the front door and the rear door reply simultaneously by failing to transmit an OK signal, the sequence of the interrogation can be defined, for example, as a function of whether the rear seat is unoccupied. If the rear seat is not occupied, the sensor signal of the side impact sensor of the

rear door can either be completely ignored or interrogated only after the sensor signal of the front impact sensor, and appropriately evaluated.

Please replace the paragraph beginning on line 5 of page 13 with the following rewritten paragraph:

If a higher number of slave units is desired, it is possible, for example, to expand the protocol length to 24 bits, in which case the following bit assignment can be provided: 3 start bits in the signal segment 8; 5 command or address bits in the signal segment 9; and 16 information bits in the signal segments 10 and 11. In this case, the transmission of a slave information item at the above-mentioned transmission rate of 125 kbaud can last between 384 microseconds and 768 microseconds. If more rapid transmission is required, the transmission rate can be increased. If it is doubled to 250 kbaud, the transmission of an information item from a slave unit then takes between 192 microseconds and 384 microseconds.

On page 14, line 1, please replace "Patent Claims" with --WHAT IS CLAIMED IS--.

In the Claims:

1. (Amended) A method of data transmission, comprising: transmitting an interrogation signal in a polling mode from a superordinate control unit to function units via a data bus;

and transmitting a confirmation signal by the function units which are functioning and do not have any information to send, and when a confirmation signal is not received from a function unit, the superordinate control unit outputs a command signal which addresses the function unit and selectively causes it to transmit data.

2. (Amended) The method as claimed in claim 1, wherein the interrogation signal is transmitted cyclically.

3. (Amended) The method as claimed in claim 1, wherein the function units comprise impact and/or vehicle occupant detection sensors of a motor vehicle occupant protection system.

4. (Amended) The data transmission system as claimed in claim 11, wherein the function units comprise firing caps for firing vehicle occupant protection means of a motor vehicle occupant protection system.

5. (Amended) The data transmission system as claimed in claim 11, wherein the interrogation signal comprises first signal segment for transmitting a polling command and a second signal segment which adjoins the second signal segment and which includes a multiplicity of regular voltage pulses which alternate between high and low potential.

6. (Amended) The method as claimed in claim 1, wherein the function units transmit confirmation signals in the form of current pulses during low level phases of voltage pulses of the signal segment.

7. (Amended) The method as claimed in claim 1, wherein the command signal has the same structure as the interrogation signal, and an address signal segment is provided instead of the signal segment which predefines the polling mode.

8. (Amended) The method as claimed in claim 7, wherein an addressed function unit transmits its information in the form of current pulses during low level phases of voltage pulses of the command signal which adjoin the address segment, and generate check bits which are transmitted to the superordinate control unit after the transmission of information during further low-level phases of the command signal.

9. (Amended) A data transmission system, comprising:

a superordinate control unit; and

a plurality of function units which are connected to the control/unit via a common data bus, in which the superordinate control unit is configured to repeatedly transmit an interrogation signal to the function units via the data bus, the interrogation signal requesting the function units to acknowledge the confirmation signal, and when the confirmation signal of one of the plurality of function units is not received, the control unit outputs a command signal which addresses the function unit and which requests it to transmit an information signal to the control unit.

10. (Amended) The data transmission system as claimed in claim 9, wherein the function units have voltage regulators which are connected to the data bus on the input side and which generate the supply voltage for the respective function unit from the interrogation signals and command signals.

11. (New) A data transmission system, comprising:

a superordinate control unit; and

a plurality of function units which are connected to the control unit via a common data bus and in which an interrogation signal is transmitted in a polling mode from the superordinate control unit to the plurality of function units via the data bus, wherein

a confirmation signal is transmitted by the function units which are functioning correctly and do not have any information to send, and

when a confirmation signal is not received from one of the plurality of function units, the superordinate control unit outputs a command signal which addresses the function unit and selectively causes it to transmit data.

In the Abstract:

Please replace the Abstract in its entirety with the Abstract attached hereto.

REMARKS

The above amendments to the specification, claims and abstract have been made to place the application in proper U.S. format and to conform with proper grammatical and idiomatic English. None of the amendments herein are made for reasons related to patentability. No new matter has been added.

Attached hereto is a marked-up version of the changes made to the specification and claims by the current amendment. The attached page is captioned "**Version with markings to show changes made**".

In the unlikely event that the transmittal letter is separated from this document and the Patent Office determines that an extension and/or other relief is required, applicant petitions for any required relief including extensions of time and authorizes the Commissioner to charge the cost of such petitions and/or other fees due in connection with the filing of this document to **Deposit Account No. 03-1952** referencing docket no. 449122009000. However, the Commissioner is not authorized to charge the cost of the issue fee to the Deposit Account.

Respectfully submitted,

Dated: September 4, 2001

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VERSION WITH MARKINGS TO SHOW CHANGES MADE

For the convenience of the Examiner, the changes made are shown below with deleted text in strikethrough and added text in underline.

In the Specification:

Page 1 before the first paragraph, please delete the following:

~~Description~~

Please amend the title as follows:

DATA TRANSMISSION METHOD AND SYSTEM IN A MOTOR VEHICLE OCCUPANT PROTECTION SYSTEM

Page 1, between lines 8 and 9 has been amended to include the following:

CLAIM FOR PRIORITY

This application claims priority to International Application No. PCT/DE00/00619 which was published in the German language on September 8, 2000.

TECHNICAL FIELD OF THE INVENTION

Paragraph beginning on line 6 of page 1 has been amended as follows:

The invention relates to a data transmission method and system, and in particular, to a data transmission method and system in a motor vehicle occupant protection system ~~according to the master/slave principle~~.

Page 1, between lines 8 and 9 has been amended to include the following:

BACKGROUND OF THE INVENTION

Paragraph beginning on line 9 of page 1 has been amended as follows:

EP 0 507 581 A1 discloses a data transmission system in which ~~a multiplicity of~~ multiplex nodes ~~is~~ are connected to a common bus line. In order to update the system, the multiplex nodes can transmit specific protocol words which comprise a data segment specifying a multiplex node group, and a confirmation signal segment. During the confirmation signal segment, each addressed multiplex node which is associated with the selected group can emit a confirmation signal. If ~~not~~ all of the addressed multiplex nodes reply with a confirmation signal, the protocol word is repeated twice, for example. If some of the addressed multiplex nodes have ~~then~~ still not replied, the nodes which do not reply are excluded from the registration list which lists the active nodes. If, on the other hand, a node which has not been active until then should reply for the first time, the registration list is supplemented with this node which replies for the first time.

Paragraph beginning on line 28 of page 1 has been amended as follows:

With such a configuration, the known transmission collision problem, in which two or more nodes try to transmit at essentially the same time, may occur. In order to solve this problem, a priority sequence for the transmission authorization has to be predefined in each node, ~~said~~ the priority sequence blocking transmission access to nodes with lower priority for as long as nodes with higher priority are transmitting. Therefore, before each bus access each node ~~must~~ checks whether a node with a higher priority is not already transmitting, which can lead to a certain delay in the transmission of signals. In addition, a change in the fixed priority sequence is also problematic because ~~said~~ the change has to be registered selectively in ~~all~~ the multiplex nodes. In addition, synchronization problems may occur if the aim is to synchronize the timing clock of the operation of the individual multiplex nodes. In such a case, additional synchronization ~~steps are~~ is necessary.

Page 1, between lines 10 and 11 has been amended to include the following:

SUMMARY OF THE INVENTION

In one embodiment of the invention, there is a method of data transmission, comprising: transmitting an interrogation signal in a polling mode from a superordinate control unit to function units via a data bus, and transmitting a confirmation signal by the function units which are functioning and do not have any information to send, and when a confirmation signal is not received from a function unit, the superordinate control unit outputs a command signal which addresses the function unit and selectively causes it to transmit data.

In one aspect of the invention, the interrogation signal is transmitted cyclically.

In another aspect of the invention, the function units comprise impact and/or vehicle occupant detection sensors of a motor vehicle occupant protection system.

In still another aspect of the invention, the function units comprise firing caps for firing vehicle occupant protection means of a motor vehicle occupant protection system.

In yet another aspect of the invention, the interrogation signal comprises first signal segment for transmitting a polling command and a second signal segment which adjoins the second signal segment and which includes a multiplicity of regular voltage pulses which alternate between high and low potential.

In another aspect of the invention, the function units transmit confirmation signals in the form of current pulses during low level phases of voltage pulses of the signal segment.

In yet another aspect of the invention, the command signal has the same structure as the interrogation signal, and an address signal segment is provided instead of the signal segment which predefines the polling mode.

In still another aspect of the invention, an addressed function unit transmits its information in the form of current pulses during low level phases of voltage pulses of the command signal which adjoin the address segment, and generate check bits which are

transmitted to the superordinate control unit after the transmission of information during further low-level phases of the command signal.

In another embodiment of the invention, there is a superordinate control unit; and a plurality of function units which are connected to the control/unit via a common data bus, in which the superordinate control unit is configured to repeatedly transmit an interrogation signal to the function units via the data bus, the interrogation signal requesting the function units to acknowledge the confirmation signal, and when the confirmation signal of one of the plurality of function units is not received, the control unit outputs a command signal which addresses the function unit and which requests it to transmit an information signal to the control unit.

In another aspect of the invention, the function units have voltage regulators which are connected to the data bus on the input side and which generate the supply voltage for the respective function unit from the interrogation signals and command signals.

In still another embodiment of the invention, there is a superordinate control unit; and a plurality of function units which are connected to the control unit via a common data bus and in which an interrogation signal is transmitted in a polling mode from the superordinate control unit to the plurality of function units via the data bus, and a confirmation signal is transmitted by the function units which are functioning correctly and do not have any information to send, and when a confirmation signal is not received from one of the plurality of function units, the superordinate control unit outputs a command signal which addresses the function unit and selectively causes it to transmit data.

BRIEF DESCRIPTION OF THE DRAWINGS

The invention is described in more detail below by means of an exemplary embodiment and with reference to the drawings, in which:

Fig. 1 shows a schematic block circuit diagram of an exemplary embodiment of the data transmission system.

Fig. 2 shows the structure of the data words used for communication between the master and slave units.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

Paragraph beginning on line 12 of page 2 has been amended as follows:

The invention ~~is based on the object of providing~~ provides a data transmission method which permits efficient data transmission without collision problems.

Paragraph beginning on line 16 of page 2 has been amended as follows:

~~This object is achieved with the measures specified in patent claim 1.~~

Paragraph beginning on line 19 of page 2 has been amended as follows:

~~Furthermore, the~~ The invention also discloses ~~makes available~~ a data transmission system ~~as claimed in patent claim 9,~~ which is distinguished by efficient, collision-free transmission of data.

Paragraph beginning on line 24 of page 2 has been amended as follows:

~~Advantageous embodiments of the invention are specified in the subclaims.~~

Paragraph beginning on line 27 of page 2 has been amended as follows:

In the invention, the master/slave principle is used, the superordinate control unit performing the master function and exercising complete control of the data traffic on the data bus. Function units which are connected to the data bus are operated as slaves and interrogated repeatedly, preferably cyclically, in the polling mode. Function units which operate satisfactorily, and which ~~also~~ do not ~~wish to~~ emit any message, reply to each polling interrogation with a confirmation signal. If, however, the confirmation signal is not received

from one or more function units, the superordinate control unit can address the function unit(s) ~~this function unit/these function units~~ in a targeted and selective fashion and provide ~~it~~/them with the possibility of transmitting a respective ~~its/their~~ message. This ensures that relatively rapid data transmission can take place without the risk of any collision problems. If a selectively addressed function unit ~~then nevertheless~~ does not transmit a message, this is an indication of a functional fault. ~~in this function unit so that~~ Hence, the superordinate control unit can generate a corresponding fault message for rapid fault clearance, for example in the form of a visual or audible indication to the system user and/or in the form of a data entry in an operating monitoring protocol. Thus, not only is the data flow on the data bus selectively controlled in each case by the invention so that no collision problems occur, but ~~also at the same time~~ a diagnostic function is also achieved at the same time.

Paragraph beginning on line 19 of page 3 has been amended as follows:

When the invention is used in a motor vehicle, in particular a motor vehicle occupant protection system, the function units may be, for example, impact sensors or vehicle occupant detection sensors (seat occupation sensors). The function units can also alternatively or additionally be firing caps for firing vehicle occupant protection means or ~~else~~ any other desired components. In ~~all~~ each cases, a multiple access of the function units to the data bus, and thus a possibility of a collision with a delayed transmission of signaling signals (for example sensor signals or sensor states) is avoided. The superordinate control unit ~~alone~~ determines the communications in each case. If the control system is a centralized one, the central control unit forms the superordinate control unit. In a decentralized system it is also possible for there to be a plurality of superordinate control units (masters) which each have selectively permanently assigned function units (slaves). In each ~~all~~ cases, a very rapid transmission of data is ensured.

Paragraph beginning on line 1 of page 4 has been amended as follows:

The superordinate control unit can itself determine the priority sequence with which function units which do not reply during the polling mode are interrogated, and if appropriate also change ~~said~~ the priority sequence at any time, for example as a function of the results of the seat occupation detection. In order to define priorities, and if appropriate change them, there is ~~thus~~ no need for intervention in the subordinate function units so that the priority sequence can be defined very rapidly and without additional data communication via the data bus. In addition, during the polling mode the subordinate function units (slaves) have to continuously actively reply.~~, that is to say~~ That is, they emit an OK message. The bus architecture is thus very well suited for a system with active function elements, in particular sensors.

Paragraph beginning on line 18 of page 4 has been amended as follows:

In addition to the transmission of information, the supply energy can also be transmitted from the superordinate control unit to the function unit via the bus by virtue of the fact that the transmission protocol, ~~that is to say~~ i.e., the exchange of data between the master and the slaves, preferably operates ~~only~~ in a bipolar fashion, i.e. changes between 0 and 1. In addition, the cyclical polling interrogation also continuously transmits a clock frequency so that the entire bus system can operate synchronously. In particular if there is a phase change at each bit of the polling command, the average value of the signal does not ~~essentially~~ necessarily change during the data transmission so that energy can be made available continuously.

Paragraph beginning on line 34 of page 4 has been amended as follows:

The function units preferably reply in their time window with current pulses, ~~that is to say~~ i.e., by appropriately loading the data bus with current so that the average value of the voltage is not varied, and at the same time the OK state is nevertheless reliably signaled to the superordinate control unit.

Paragraph beginning on line 1 of page 5 has been amended as follows:

The function units consequently do not require any separate clock. If they nevertheless have separate a clock generating device ~~means~~, this can be triggered and synchronized by the "1" bits transmitted by the superordinate control unit. In addition, the supply of energy to the function units for their operation is ~~very~~ even, which is also ensured by the sequence of "1" bits provided in the polling command.

Paragraph beginning on line 10 of page 5 has been amended as follows:

The invention can be used in a sensor bus or a firing bus for vehicle occupant protection systems, or ~~even~~ in any other desired bus system. In the two first-mentioned cases, the superordinate control unit is formed, for example, by a central airbag control unit which continuously maintains control over all the sensors and/or firing caps.

Paragraph beginning on line 18 of page 5 has been amended as follows:

~~The invention is described in more detail below by means of an exemplary embodiment and with reference to the drawings, in which:~~

Paragraph beginning on line 22 of page 5 has been amended as follows:

~~fig. 1 shows a schematic block circuit diagram of an exemplary embodiment of the data transmission system, and~~

Paragraph beginning on line 26 of page 5 has been amended as follows:

~~fig. 2 shows the structure of the data words used for communication between the master and slave units.~~

Paragraph beginning on line 30 of page 5 has been amended as follows:

In the data transmission system shown in Ffig. 1, there is a superordinate control unit 3 which is embodied ~~here~~ as a central control unit and which controls the communication as a master unit. The control unit 3 is connected via a common data bus 1 to functions units 2, 4, 5 and 6 which are embodied ~~here~~ as sensors. The function units can, however, also be firing caps or other control components or can be composed of a combination of sensors and firing caps or other elements. The data bus 1 is preferably embodied as a two-wire line and is used not only for transmitting data but also for supplying energy to the function units 2, 4, 5 and 6. The data bus can additionally also serve as a control bus, that is to say transmit control instructions.

Paragraph beginning on line 10 of page 6 has been amended as follows:

The exemplary embodiment shown is embodied as a data transmission system of a motor vehicle occupant protection system in which the sensor 2 is used as a seat occupation sensor which detects whether the front passenger seat and/or the rear seats of the motor vehicle are actually occupied. A separate seat occupation sensor 2 is provided for each monitored seat. Because the seat occupation state generally does not change during the travel mode, the seat occupation state ~~only has to be~~ is interrogated at the start of the travel mode, and possibly at large time intervals, so that the frequency of sensor interrogations can be very low. Instead of seat occupation sensors 2, it is ~~generally~~ also possible to provide vehicle occupant detection sensors which are based on some other principle and which can detect the presence of passengers on the front passenger seat and/or the rear seats of the motor vehicle. This is used ~~important~~ for suppressing the triggering of vehicle occupant protection device ~~means~~ of seats which are not occupied, for example of airbags or seat belt pretensioning systems.

Paragraph beginning on line 32 of page 6 has been amended as follows:

The sensors 4 to 6 are impact sensors for detecting an impact and the location of its action, and if appropriate the direction of its action. The sensors 4 to 6 are arranged in a known fashion at a central point on the motor vehicle and at the front, rear and/or sides of the motor

vehicle, the number of sensors being variable depending on the design specifications. The sensors comprise ~~constitute~~ the slave units of the superordinate control unit (master) 3.

Paragraph beginning on line 4 of page 7 has been amended as follows:

Fig. 2 illustrates the structure of the data words 7 which are repeatedly emitted by the central control unit 3. These data words 7 are output quasi-permanently, at least during the travel mode of the motor vehicle after the minimum speed has been exceeded in order to trigger the vehicle occupant protection system when there is an accident, ~~that is to say said~~ That is, the data words 7 are repeated cyclically in a fault-free situation without or with ~~only~~ a short time interval. The data word 7 is a unipolar voltage signal whose voltage states change between a higher and a lower voltage value. This ensures that a voltage continues to be applied to the transmission line so that acknowledgement in the form of current pulses, for example by ~~means of~~ a simple impedance loading, is possible. According to Fig. 2, the data word is present in the form of a biphase code in which a "one" is signaled by phase change in the center of a bit, whereas a "0" is represented by a phase change ~~only~~ at the end of a bit. The data word 7 is a 16-bit signal. The bit numbers are plotted on the bit axis illustrated underneath the data word 7.

Paragraph beginning on line 27 of page 7 has been amended as follows:

Each data word 7 comprises the signal segments 8 to 11 shown in Fig. 2. The signal segment 8 is composed of two start bits, which signal the start of the data word and are represented by two zeros. This is followed by the signal segment 9 in which either a specific command, in particular a polling command, or an address of a function unit which is to be addressed, in particular of a sensor 2, 4, 5 or 6, is transmitted. The signal segment 9 here comprises the bits 3 to 6 of the data word. During the following signal segments 10 and 11 (bits 7 to 16) the control unit 3 transmits a sequence of logic "1" in the polling mode (in this case the polling command is predefined in the signal segment 9) so that a signal level change from "H" to "L" occurs in the center of each bit 7 to 16. The second half of each bit 7 to 16 therefore has a

relatively low voltage level. During this low voltage level, the sensors which are connected to the data bus 1 can transmit back their OK messages to the control unit 3 in the form of current-modulated pulses, the current modulation being caused by the data bus being loaded by the respectively transmitting sensor. For example, a sensor, ~~that is to say~~ i.e., the communications device provided in it, can connect a load resistor to the data bus 1 during the low level phase of the bit assigned to it from the data word 7 so that current loading of the data bus 1, detectable by the control unit 3 (master), is brought about. This current loading pulse comprises ~~constitutes~~ the "OK" message of the respective sensor. Each slave unit (2, 4, 5, 6) is selectively assigned a fixed bit during the polling mode, during which it can emit its status message, for example the bit "7" for the sensor 4, the bit "8" for the sensor 5, etc. Consequently, the data word 7 illustrated can be used to address slave units (bits 7 to 16) during the polling mode 10. The respective bits 7 to 16 of the data word 7 thus define the respective addresses of the slave units in the polling mode. If there are fewer slave units than bits present in the signal segments 10 and 11, two or more bits for making acknowledgments can be made available to one, more or if appropriate even all the slave units so that they can emit more detailed acknowledgements, for example "OK", "urgent message", "normal message" and the like. One or more of these bits can then serve in each case as a checkbit/checkbits for the acknowledgement.

Paragraph beginning on line 1 of page 9 has been amended as follows:

During the polling mode, the slave units ~~must~~ therefore reply actively in their time window (by means of a current pulse) and as a result signal their satisfactory state (no internal function faults, no impact, there is no other message to emit). However, if a slave unit is faulty or ~~else~~ wishes to transmit a message to the master unit in a targeted fashion, ~~said~~ the slave unit signals this to the master unit by failing to emit a loading pulse during the bit assigned to it during the polling mode. The master unit 3 detects this absence of an acknowledgement from the slave unit and ~~then~~ changes ~~immediately~~ from the polling mode to selective addressing of the slave unit which does not reply. In this case, the address which is assigned to the slave unit

which does not reply is then transmitted in the next data word 7 in the signal segment 9 instead of a polling command. Because the other slave units are neither ~~now~~ addressed ~~neither~~ by means of a polling command nor by means of their own address, they remain silent, ~~that is to say~~ i.e., they do not transmit any information during the signal segments 10 and 11. The master unit 7 generates~~, in the same way as hitherto,~~ the signal segment 10 which adjoins the address 9, so that the profile shown in Fig. 2 is also obtained ~~here~~. However, ~~all~~ the bits 7 to 12 (low level phases) are then available for the addressed slave unit so that the latter can transmit a multibit message to the master unit. The slave unit can, for example, transmit a data word, a measuring level or status information which signals, for example, a crash has been detected (for example an acceleration limiting value has been exceeded, or the strength of the measured acceleration).

Paragraph beginning on line 35 of page 9 has been amended as follows:

A slave unit can therefore very quickly emit its sensor information without collision problems by virtue of the fact that it merely fails to transmit an OK message during the next polling command and is then ~~immediately~~ selectively addressed by the master unit which then fails to generate a polling command but instead generates the corresponding address in the signal segment 9 of the next data word 7, after which it can transmit its information in the form of a multibit word.

Paragraph beginning on line 8 of page 10 has been amended as follows:

However, if the selectively addressed slave unit does not make available any reasonable information during the bits 7 to 12, this is classified by the master unit as an operational fault of the slave unit (no "OK" message during a polling command, no evaluable information during the selective addressing of the slave unit). Such a slave unit which is detected as faulty can be gated out during the following polling mode, ~~that is to say~~ i.e., is ~~then~~ not checked once more after each polling command. A status enquiry or communication then takes place ~~only~~ with the other slave units.

Paragraph beginning on line 21 of page 10 has been amended as follows:

This transmission authorization control avoids a situation in which a plurality of slave units can access the bus simultaneously, with the result that there is no risk of a collision. At the same time there is the advantage that the master unit does not have to receive any asynchronously transmitted slave signals so that it is possible to dispense with interrupt handling routines which are otherwise necessary. The master unit is aware in each case of those times at which the (preferably current-modulated) slave signals are to be expected.

Paragraph beginning on line 33 of page 10 has been amended as follows:

Furthermore, it is advantageous ~~here~~ that the slave units do not require their own clock because they can be clocked by the clock of the master unit. If the slave units nevertheless have their own clock generating device ~~means~~, this can be triggered and/or synchronized at any time by the "ones" transmitted by the master unit. The clock frequency is continuously transmitted by the master unit on the basis of the data word forming device ~~means~~ 7, and can thus bring about the synchronization of the entire bus system.

Paragraph beginning on line 6 of page 11 has been amended as follows:

If the address of a single slave unit is transmitted in the signal segment 9, the bits in the signal segment 11 (bits 13 to 16) are used to transmit checkbits, for example a fault detection and/or correction code, for example CRC4. The master unit itself does not generate a separate error check code in this case but rather generates the bits of the signal segment 11 with the profile shown in Fig. 2, that is to say in an identical way to the transmission of a polling command. However, the addressed slave unit is programmed in such a way that it carries out, for example according to the CRC method, a fault detection routine by ~~means of~~ its own address and also the information which is generated by it and is to be transmitted to the master unit in the low level phases of the signal segment 10. The fault detection word and/or fault correction word

formed ~~here~~ is transmitted to the master unit in the low level phases of the signal segment 11. The master unit checks the checkbits received in the signal segment 11, taking into account the slave address (in the signal segment 9) generated by it and the slave information (in the low level phases of the signal segment 10) received by it, and on the basis of the fault check which is known ~~here~~ and used in the slave unit. If, for example, the checksum formed ~~here~~ differs from the checksum transmitted by the slave unit, this ~~constitutes an indication of~~ indicates a fault either in the transmission or in the connected slave unit. In the event of the detection of a fault, suitable fault clearance routines can be carried out, for example transmitting the selectively addressed data word 7 once more from the master unit to the data bus 1 in order to cause the addressed slave unit to generate signals once more.

Paragraph beginning on line 1 of page 12 has been amended as follows:

During the polling interrogation, a situation may also occur in which two or more slave units do not reply with their response signal (current pulse in the assigned bit) because they want, for example, to transmit simultaneously or are connected to the bus in a faulty way, or not at all. In such a case, the master unit can define in what sequence it interrogates the non-replying slave units, on the basis of a priority sequence which is stored in it or generated. The priority sequence can be variable as a function of further parameters, for example the seat condition status. Because only the master unit includes ~~contains~~ and defines the priority sequence, a priority change can be carried out without difficulty and extremely rapidly. If, for example, two side impact sensors on the front door and the rear door reply simultaneously by failing to transmit an OK signal, the sequence of the interrogation can be defined, for example, as a function of whether ~~or not~~ the rear seat is unoccupied. If the rear seat is not occupied, the sensor signal of the side impact sensor of the rear door can either be completely ignored or interrogated only after the sensor signal of the front impact sensor, and appropriately evaluated.

Paragraph beginning on line 5 of page 13 has been amended as follows:

If a higher number of slave units is desired, it is possible, for example, to expand the protocol length to 24 bits, in which case the following bit assignment can be provided: 3 start bits in the signal segment 8; 5 command or address bits in the signal segment 9; and 16 information bits in the signal segments 10 and 11. In this case, the transmission of a slave information item at the above-mentioned transmission rate of 125 kbaud can last between 384 microseconds and 768 microseconds. If more rapid transmission is required, the transmission rate can be increased. If it is doubled to 250 kbaud, the transmission of an information item from a slave unit then ~~only~~ takes between 192 microseconds and 384 microseconds.

On page 14, line 1, please replace "Patent Claims" with --WHAT IS CLAIMED IS--.

In the Claims:

1. (Amended) A ~~data transmission~~ method of ~~in a~~ data transmission, comprising:

transmitting ~~system which has a superordinate control unit (3) and a plurality of function units (2, 4, 5, 6) which are connected to the latter via a common data bus (1) and in which~~ an interrogation signal ~~(7) is transmitted~~ in a polling mode from ~~the~~ a superordinate control unit ~~(3)~~ to ~~the~~ function units ~~(2, 4, 5, 6)~~ via a ~~the~~ data bus ~~(1),~~; and

~~a~~ transmitting a confirmation signal ~~is transmitted back by those~~ by the function units which are functioning ~~correctly~~ and do not have any information to send, and ~~in which,~~ when a confirmation signal is not received from a function unit, the superordinate control unit ~~(3)~~ outputs a command signal which ~~specifically~~ addresses ~~said~~ the function unit and selectively causes it to transmit data.

2. (Amended) The ~~data transmission~~ method as claimed in claim 1, wherein ~~characterized in that~~ the interrogation signal ~~(7)~~ is transmitted cyclically.

3. (Amended) The ~~data transmission~~ method as claimed in claim 1, wherein ~~or 2, characterized in that~~ the function units ~~(2, 4, 5, 6)~~ comprise impact and/or vehicle occupant detection sensors of a motor vehicle occupant protection system.

4. (Amended) The data transmission system as claimed in claim 11, wherein ~~one of the preceding claims, characterized in that~~ the function units comprise firing caps for firing vehicle occupant protection means of a motor vehicle occupant protection system.

5. (Amended) The data transmission system as claimed in claim 11, wherein ~~one of the preceding claims, characterized in that~~ the interrogation signal ~~(7)~~ comprises a first signal segment ~~(9)~~ for transmitting a polling command and a ~~further~~ second signal segment ~~(10, 11)~~

which adjoins the second ~~said~~ signal segment ~~(9)~~ and which ~~contains~~ includes a multiplicity of regular voltage pulses which alternate between high and low potential.

6. (Amended) The ~~data transmission~~ method as claimed in claim 1 ~~5~~, wherein ~~characterized in that~~ the function units transmit ~~their~~ confirmation signals in the form of current pulses during ~~the~~ low level phases of ~~the~~ voltage pulses of the ~~further~~ signal segment ~~(10, 11)~~.

7. (Amended) The ~~data transmission~~ method as claimed in claim 1, wherein ~~one of the preceding claims, characterized in that~~ the command signal has the same structure as the interrogation signal, and ~~but~~ an address signal segment is provided instead of the signal segment ~~(9)~~ which predefines the polling mode.

8. (Amended) The ~~data transmission~~ method as claimed in claim 7, wherein ~~characterized in that~~ an addressed function unit transmits its information in the form of current pulses during low level phases of voltage pulses of the command signal which adjoin the address segment, and ~~additionally~~ generates check bits which are transmitted to the superordinate control unit ~~(2)~~ after the transmission of information during further low-level phases of the command signal.

9. (Amended) A data transmission system, comprising: ~~which has~~

a superordinate control unit; and

~~(3) and~~ a plurality of function units ~~(2, 4, 5, 6)~~ which are connected to the control/unit ~~latter~~ via a common data bus ~~(1)~~, in which the superordinate control unit ~~(2)~~ is configured ~~in such a way that it~~ to repeatedly transmits an interrogation signal ~~(7)~~ to the function units via the data bus ~~(1)~~, ~~said~~ the interrogation signal ~~(7)~~ requesting the function units to acknowledge the confirmation signal ~~which signals that they are operating correctly~~, and ~~in which,~~ when the confirmation signal of one of the plurality of a function units is not received, the control unit ~~(3)~~

outputs a command signal which ~~specifically~~ addresses the ~~said~~ function unit and which requests it to transmit an information signal to the control unit.

10. (Amended) The data transmission system as claimed in claim 9, ~~in which~~ wherein the function units ~~(2, 4, 5, 6)~~ have voltage regulators which are connected to the data bus ~~(1)~~ on the input side and which generate the ~~d.c.~~ supply voltage for the respective function unit from the interrogation signals and command signals.

11. (New) A data transmission system, comprising:

a superordinate control unit; and

a plurality of function units which are connected to the control unit via a common data bus and in which an interrogation signal is transmitted in a polling mode from the superordinate control unit to the plurality of function units via the data bus, wherein

a confirmation signal is transmitted by the function units which are functioning correctly and do not have any information to send, and

when a confirmation signal is not received from one of the plurality of function units, the superordinate control unit outputs a command signal which addresses the function unit and selectively causes it to transmit data.

In the Abstract:

Please replace the Abstract in its entirety with the Abstract attached hereto.

DATA TRANSMISSION METHOD AND SYSTEM IN A MOTOR VEHICLE OCCUPANT PROTECTION SYSTEM

Abstract

According to the invention, impact sensors are repeatedly interrogated during a polling mode and have to actively reply by emitting current pulses. If a sensor does not reply it is selectively addressed and can at that point signal a desired message. The master unit has full communications control over the bus so that data collisions can be avoided and very rapid transmission of the sensor signal is achieved. The master unit can change the communication priorities at any time.

Serial No. Not yet Assigned
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Description

Data transmission method and system, in particular in a motor vehicle occupant protection system

The invention relates to a data transmission method and system according to the master/slave principle.

EP 0 507 581 A1 discloses a data transmission system in which a multiplicity of multiplex nodes is connected to a common bus line. In order to update the system, the multiplex nodes can transmit specific protocol words which comprise a data segment specifying a multiplex node group, and a confirmation signal segment. During the confirmation signal segment, each addressed multiplex node which is associated with the selected group can emit a confirmation signal. If not all the addressed multiplex nodes reply with a confirmation signal, the protocol word is repeated twice, for example. If some of the addressed multiplex nodes have then still not replied, the nodes which do not reply are excluded from the registration list which lists the active nodes. If, on the other hand, a node which has not been active until then should reply for the first time, the registration list is supplemented with this node which replies for the first time.

With such a configuration, the known transmission collision problem, in which two or more nodes try to transmit at essentially the same time, may occur. In order to solve this problem, a priority sequence for the transmission authorization has to be predefined in each node, said priority sequence blocking transmission access to nodes with lower priority for as long as nodes with higher priority are transmitting. Therefore, before each bus access each node must check whether a

node with a higher priority is not already transmitting, which can lead to a certain delay in the transmission of signals. In addition, a change in the fixed priority sequence is also problematic because said change has to be registered selectively in all the multiplex nodes. In addition, synchronization problems may occur if the aim is to synchronize the timing clock of the operation of the individual multiplex nodes. In such a case, additional synchronization steps are necessary.

The invention is based on the object of providing a data transmission method which permits efficient data transmission without collision problems.

This object is achieved with the measures specified in patent claim 1.

Furthermore, the invention makes available a data transmission system as claimed in patent claim 9, which is distinguished by efficient, collision-free transmission of data.

Advantageous embodiments of the invention are specified in the subclaims.

In the invention, the master/slave principle is used, the superordinate control unit performing the master function and exercising complete control of the data traffic on the data bus. Function units which are connected to the data bus are operated as slaves and interrogated repeatedly, preferably cyclically, in the polling mode. Function units which operate satisfactorily, and which also do not wish to emit any message, reply to each polling interrogation with a confirmation signal. If, however, the confirmation signal is not received from one or more function units, the superordinate control unit can

address this function unit/these function units in a targeted and selective fashion and provide it/them with the possibility of transmitting its/their message. This ensures that relatively rapid data transmission can take place without the risk of any collision problems. If a selectively addressed function unit then nevertheless does not transmit a message, this is an indication of a functional fault in this function unit so that the superordinate control unit can generate a corresponding fault message for rapid fault clearance, for example in the form of a visual or audible indication to the system user and/or in the form of a data entry in an operating monitoring protocol. Thus, not only is the data flow on the data bus selectively controlled in each case by the invention so that no collision problems occur, but at the same time a diagnostic function is also achieved.

When the invention is used in a motor vehicle, in particular a motor vehicle occupant protection system, the function units may be, for example, impact sensors or vehicle occupant detection sensors (seat occupation sensors). The function units can also alternatively or additionally be firing caps for firing vehicle occupant protection means or else any other desired components. In all cases, a multiple access of the function units to the data bus, and thus a possibility of a collision with a delayed transmission of signaling signals (for example sensor signals or sensor states) is avoided. The superordinate control unit alone determines the communications in each case. If the control system is a centralized one, the central control unit forms the superordinate control unit. In a decentralized system it is also possible for there to be a plurality of superordinate control units (masters) which each have selectively permanently assigned function units (slaves). In all cases, a very rapid transmission of data is ensured.

The superordinate control unit can itself determine the priority sequence with which function units which do not reply during the polling mode are interrogated, and if appropriate also change said priority sequence at any time, for example as a function of the results of the seat occupation detection. In order to define priorities, and if appropriate change them, there is thus no need for intervention in the subordinate function units so that the priority sequence can be defined very rapidly and without additional data communication via the data bus. In addition, during the polling mode the subordinate function units (slaves) have to continuously actively reply, that is to say emit an OK message. The bus architecture is thus very well suited for a system with active function elements, in particular sensors.

In addition to the transmission of information, the supply energy can also be transmitted from the superordinate control unit to the function unit via the bus by virtue of the fact that the transmission protocol, that is to say the exchange of data between the master and the slaves, preferably operates only in a bipolar fashion, i.e. changes between 0 and 1. In addition, the cyclical polling interrogation also continuously transmits a clock frequency so that the entire bus system can operate synchronously. In particular if there is a phase change at each bit of the polling command, the average value of the signal does not essentially change during the data transmission so that energy can be made available continuously.

The function units preferably reply in their time window with current pulses, that is to say by appropriately loading the data bus with current so that

the average value of the voltage is not varied, and at the same time the OK state is nevertheless reliably signaled to the superordinate control unit.

The function units consequently do not require any separate clock. If they nevertheless have separate clock generating means, this can be triggered and synchronized by the "1" bits transmitted by the superordinate control unit. In addition, the supply of energy to the function units for their operation is very even, which is also ensured by the sequence of "1" bits provided in the polling command.

The invention can be used in a sensor bus or a firing bus for vehicle occupant protection systems, or even in any other desired bus system. In the two first-mentioned cases, the superordinate control unit is formed, for example, by a central airbag control unit which continuously maintains control over all the sensors and/or firing caps.

The invention is described in more detail below by means of an exemplary embodiment and with reference to the drawings, in which:

fig. 1 shows a schematic block circuit diagram of an exemplary embodiment of the data transmission system, and

fig. 2 shows the structure of the data words used for communication between the master and slave units.

In the data transmission system shown in fig. 1, there is a superordinate control unit 3 which is embodied here as a central control unit and which controls the communication as a master unit. The control unit 3 is connected via a common data bus 1 to functions units 2, 4, 5 and 6 which are embodied here as sensors. The function units can, however, also be firing caps or other

control components or can be composed of a combination of sensors and firing caps or other elements. The data bus 1 is preferably embodied as a bi-wire line and is used not only for transmitting data but also for supplying energy to the function units 2, 4, 5 and 6. The data bus can additionally also serve as a control bus, that is to say transmit control instructions.

The exemplary embodiment shown is embodied as a data transmission system of a motor vehicle occupant protection system in which the sensor 2 is used as a seat occupation sensor which detects whether the front passenger seat and/or the rear seats of the motor vehicle are actually occupied. A separate seat occupation sensor 2 is provided for each monitored seat. Because the seat occupation state generally does not change during the travel mode, the seat occupation state only has to be interrogated at the start of the travel mode, and possibly at large time intervals, so that the frequency of sensor interrogations can be very low. Instead of seat occupation sensors 2, it is generally also possible to provide vehicle occupant detection sensors which are based on some other principle and which can detect the presence of passengers on the front passenger seat and/or the rear seats of the motor vehicle. This is important for suppressing the triggering of vehicle occupant protection means of seats which are not occupied, for example of airbags or seat belt pretensioning systems.

The sensors 4 to 6 are impact sensors for detecting an impact and the location of its action, and if appropriate the direction of its action. The sensors 4 to 6 are arranged in a known fashion at a central point on the motor vehicle and at the front, rear and/or sides of the motor vehicle, the number of sensors being variable depending on the design specifications. The

sensors constitute the slave units of the superordinate control unit (master) 3.

Fig. 2 illustrates the structure of the data words 7 which are repeatedly emitted by the central control unit 3. These data words 7 are output quasi-permanently at least during the travel mode of the motor vehicle after the minimum speed has been exceeded in order to trigger the vehicle occupant protection system when there is an accident, that is to say said data words 7 are repeated cyclically in a fault-free situation without or with only a short time interval. The data word 7 is a unipolar voltage signal whose voltage states change between a higher and a lower voltage value. This ensures that a voltage continues to be applied to the transmission line so that acknowledgement in the form of current pulses, for example by means of a simple impedance loading, is possible. According to Fig. 2, the data word is present in the form of a biphase code in which a "one" is signaled by phase change in the center of a bit, whereas a "0" is represented by a phase change only at the end of a bit. The data word 7 is a 16-bit signal. The bit numbers are plotted on the bit axis illustrated underneath the data word 7.

Each data word 7 comprises the signal segments 8 to 11 shown in Fig. 2. The signal segment 8 is composed of two start bits, which signal the start of the data word and are represented by two zeros. This is followed by the signal segment 9 in which either a specific command, in particular a polling command, or an address of a function unit which is to be addressed, in particular of a sensor 2, 4, 5 or 6, is transmitted. The signal segment 9 here comprises the bits 3 to 6 of the data word. During the following signal segments 10 and 11 (bits 7 to 16) the control unit 3 transmits a sequence of logic "1" in the polling mode (in this case the polling command is predefined in the signal segment 9) so that

a signal level change from "H" to "L" occurs in the center of each bit 7 to 16. The second half of each bit 7 to 16 therefore has a relatively low voltage level. During this low voltage level, the sensors which are connected to the data bus 1 can transmit back their OK messages to the control unit 3 in the form of current-modulated pulses, the current modulation being caused by the data bus being loaded by the respectively transmitting sensor. For example, a sensor, that is to say the communications device provided in it, can connect a load resistor to the data bus 1 during the low level phase of the bit assigned to it from the data word 7 so that current loading of the data bus 1, detectable by the control unit 3 (master), is brought about. This current loading pulse constitutes the "OK" message of the respective sensor. Each slave unit (2, 4, 5, 6) is selectively assigned a fixed bit during the polling mode, during which it can emit its status message, for example the bit "7" for the sensor 4, the bit "8" for the sensor 5, etc. Consequently, the data word 7 illustrated can be used to address slave units (bits 7 to 16) during the polling mode 10. The respective bits 7 to 16 of the data word 7 thus define the respective addresses of the slave units in the polling mode. If there are fewer slave units than bits present in the signal segments 10 and 11, two or more bits for making acknowledgments can be made available to one, more or if appropriate even all the slave units so that they can emit more detailed acknowledgements, for example "OK", "urgent message", "normal message" and the like. One or more of these bits can then serve in each case as a checkbit/checkbits for the acknowledgement.

During the polling mode, the slave units must therefore reply actively in their time window (by means of a current pulse) and as a result signal their satisfactory state (no internal function faults, no impact, there is no other

message to emit). However, if a slave unit is faulty or else wishes to transmit a message to the master unit in a targeted fashion, said slave unit signals this to the master unit by failing to emit a loading pulse during the bit assigned to it during the polling mode. The master unit 3 detects this absence of an acknowledgement from the slave unit and then changes immediately from the polling mode to selective addressing of the slave unit which does not reply. In this case, the address which is assigned to the slave unit which does not reply is then transmitted in the next data word 7 in the signal segment 9 instead of a polling command. Because the other slave units are now addressed neither by means of a polling command nor by means of their own address, they remain silent, that is to say they do not transmit any information during the signal segments 10 and 11. The master unit 7 generates, in the same way as hitherto, the signal segment 10 which adjoins the address 9, so that the profile shown in Fig. 2 is also obtained here. However, all the bits 7 to 12 (low level phases) are then available for the addressed slave unit so that the latter can transmit a multibit message to the master unit. The slave unit can, for example, transmit a data word, a measuring level or status information which signals, for example, a crash has been detected (for example an acceleration limiting value has been exceeded, or the strength of the measured acceleration).

A slave unit can therefore very quickly emit its sensor information without collision problems by virtue of the fact that it merely fails to transmit an OK message during the next polling command and is then immediately selectively addressed by the master unit which then fails to generate a polling command but instead generates the corresponding address in the signal segment 9 of the next data word 7, after which it can transmit its information in the form of a multibit word.

However, if the selectively addressed slave unit does not make available any reasonable information during the bits 7 to 12, this is classified by the master unit as an operational fault of the slave unit (no "OK" message during a polling command, no evaluable information during the selective addressing of the slave unit). Such a slave unit which is detected as faulty can be gated out during the following polling mode, that is to say is then not checked once more after each polling command. A status enquiry or communication then takes place only with the other slave units.

This transmission authorization control avoids a situation in which a plurality of slave units can access the bus simultaneously, with the result that there is no risk of a collision. At the same time there is the advantage that the master unit does not have to receive any asynchronously transmitted slave signals so that it is possible to dispense with interrupt handling routines which are otherwise necessary. The master unit is aware in each case of those times at which the (preferably current-modulated) slave signals are to be expected.

Furthermore, it is advantageous here that the slave units do not require their own clock because they can be clocked by the clock of the master unit. If the slave units nevertheless have their own clock generating means, this can be triggered and/or synchronized at any time by the "ones" transmitted by the master unit. The clock frequency is continuously transmitted by the master unit on the basis of the data word forming means 7, and can thus bring about the synchronization of the entire bus system.

If the address of a single slave unit is transmitted in the signal segment 9, the bits in the signal segment 11

(bits 13 to 16) are used to transmit checkbits, for example a fault detection and/or correction code, for example CRC4. The master unit itself does not generate a separate error check code in this case but rather generates the bits of the signal segment 11 with the profile shown in Fig. 2, that is to say in an identical way to the transmission of a polling command. However, the addressed slave unit is programmed in such a way that it carries out, for example according to the CRC method, a fault detection routine by means of its own address and also the information which is generated by it and is to be transmitted to the master unit in the low level phases of the signal segment 10. The fault detection word and/or fault correction word formed here is transmitted to the master unit in the low level phases of the signal segment 11. The master unit checks the checkbits received in the signal segment 11, taking into account the slave address (in the signal segment 9) generated by it and the slave information (in the low level phases of the signal segment 10) received by it, and on the basis of the fault check which is known here and used in the slave unit. If, for example, the checksum formed here differs from the checksum transmitted by the slave unit, this constitutes an indication of a fault either in the transmission or in the connected slave unit. In the event of the detection of a fault, suitable fault clearance routines can be carried out, for example transmitting the selectively addressed data word 7 once more from the master unit to the data bus 1 in order to cause the addressed slave unit to generate signals once more.

During the polling interrogation, a situation may also occur in which two or more slave units do not reply with their response signal (current pulse in the assigned bit) because they want, for example, to transmit simultaneously or are connected to the bus in a faulty way, or not at all. In such a case,

the master unit can define in what sequence it interrogates the non-replying slave units, on the basis of a priority sequence which is stored in it or generated. The priority sequence can be variable as a function of further parameters, for example the seat condition status. Because only the master unit contains and defines the priority sequence, a priority change can be carried out without difficulty and extremely rapidly. If, for example, two side impact sensors on the front door and the rear door reply simultaneously by failing to transmit an OK signal, the sequence of the interrogation can be defined, for example, as a function of whether or not the rear seat is unoccupied. If the rear seat is not occupied, the sensor signal of the side impact sensor of the rear door can either be completely ignored or interrogated only after the sensor signal of the front impact sensor, and appropriately evaluated.

Thus, by virtue of the fact that the master unit does not always continuously have control of the entire data bus 1 but can also update the priorities during the interrogation of the function units at any time, the data communication can be optimized taking into account the current conditions, for example the seat occupation conditions or the like, and nevertheless a very rapid transmission of information from a slave unit to the master unit is still ensured at all times.

In the protocol according to Fig. 2, a maximum of 10 slave units can be connected to the data bus 1. In this case, a slave unit can output its information in a time interval of 256 microseconds to 512 microseconds given a transmission rate of 125 kbaud.

If a higher number of slave units is desired, it is possible, for example, to expand the protocol length to 24 bits, in which case the following bit assignment can be provided: 3 start bits in the signal segment 8; 5 command or address bits in the signal segment 9; and 16 information bits in the signal segments 10 and 11. In this case, the transmission of a slave information item at the abovementioned transmission rate of 125 kbaud can last between 384 microseconds and 768 microseconds. If more rapid transmission is required, the transmission rate can be increased. If it is doubled to 250 kbaud, the transmission of an information item from a slave unit then only takes between 192 microseconds and 384 microseconds.

The voltage signal profile of the communication protocol shown in Fig. 2 also simultaneously ensures a continuous supply of energy to the slave units. The average value of the voltage supply does not change during the data transmission because there is a phase change at each bit. The slave units are preferably provided with a voltage regulator which is connected to the data bus 1 on the input side and which outputs the constantly regulated supply voltage for the respective slave unit on the output side.

Patent Claims

1. A data transmission method in a data transmission system which has a superordinate control unit (3) and a plurality of function units (2, 4, 5, 6) which are connected to the latter via a common data bus (1) and in which an interrogation signal (7) is transmitted in a polling mode from the superordinate control unit (3) to the function units (2, 4, 5, 6) via the data bus (1), and a confirmation signal is transmitted back by those function units which are functioning correctly and do not have any information to send, and in which, when a confirmation signal is not received from a function unit, the superordinate control unit (3) outputs a command signal which specifically addresses said function unit and selectively causes it to transmit data.

2. The data transmission method as claimed in claim 1, characterized in that the interrogation signal (7) is transmitted cyclically.

3. The data transmission method as claimed in claim 1 or 2, characterized in that the function units (2, 4, 5, 6) comprise impact and/or vehicle occupant detection sensors of a motor vehicle occupant protection system.

4. The data transmission system as claimed in one of the preceding claims, characterized in that the function units comprise firing caps for firing vehicle occupant protection means of a motor vehicle occupant protection system.

5. The data transmission system as claimed in one of the preceding claims, characterized in that the

interrogation signal (7) comprises a signal segment (9) for transmitting a polling command and a further

signal segment (10, 11) which adjoins the said signal segment (9) and which contains a multiplicity of regular voltage pulses which alternate between high and low potential.

6. The data transmission method as claimed in claim 5, characterized in that the function units transmit their confirmation signal in the form of current pulses during the low level phases of the voltage pulses of the further signal segment (10, 11).

7. The data transmission method as claimed in one of the preceding claims, characterized in that the command signal has the same structure as the interrogation signal, but an address signal segment is provided instead of the signal segment (9) which predefines the polling mode.

8. The data transmission method as claimed in claim 7, characterized in that an addressed function unit transmits its information in the form of current pulses during low level phases of voltage pulses of the command signal which adjoin the address segment, and additionally generates check bits which are transmitted to the superordinate control unit (2) after the transmission of information during further low-level phases of the command signal.

9. A data transmission system which has a superordinate control unit (3) and a plurality of function units (2, 4, 5, 6) which are connected to the latter via a common data bus (1), in which the superordinate control unit (2) is configured in such a way that it repeatedly transmits an interrogation signal (7) to the function units via

the data bus (1), said interrogation signal (7) requesting the function units to acknowledge the confirmation signal which signals that they are operating correctly, and in which, when

the confirmation signal of a function unit is not received, the control unit (3) outputs a command signal which specifically addresses said function unit and which requests it to transmit an information signal to the control unit.

10. The data transmission system as claimed in claim 9, in which the function units (2, 4, 5, 6) have voltage regulators which are connected to the data bus (1) on the input side and which generate the d.c. supply voltage for the respective function unit from the interrogation signals and command signals.

Abstract

Data transmission method and system, in particular in a motor vehicle occupant protection system

Impact sensors are repeatedly interrogated during a polling mode and have to reply actively by means of current pulses. If a sensor does not reply, it is selectively addressed and can then emit a desired message. The master unit has complete communications control over the bus so that data collisions can be avoided and a very rapid transmission of sensor signals is achieved. The master unit can change the communications priorities at any time.

(Fig. 2)

FIG 1

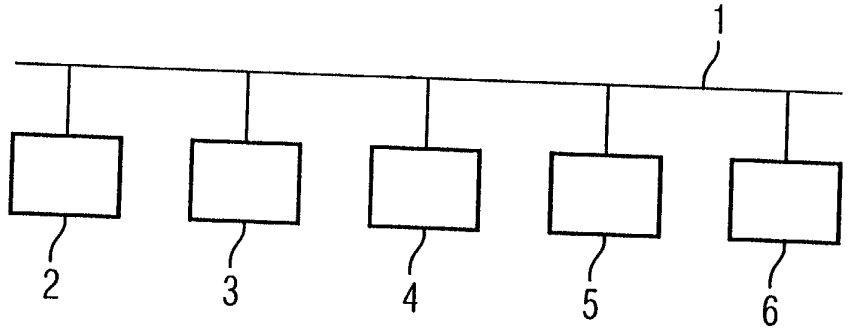
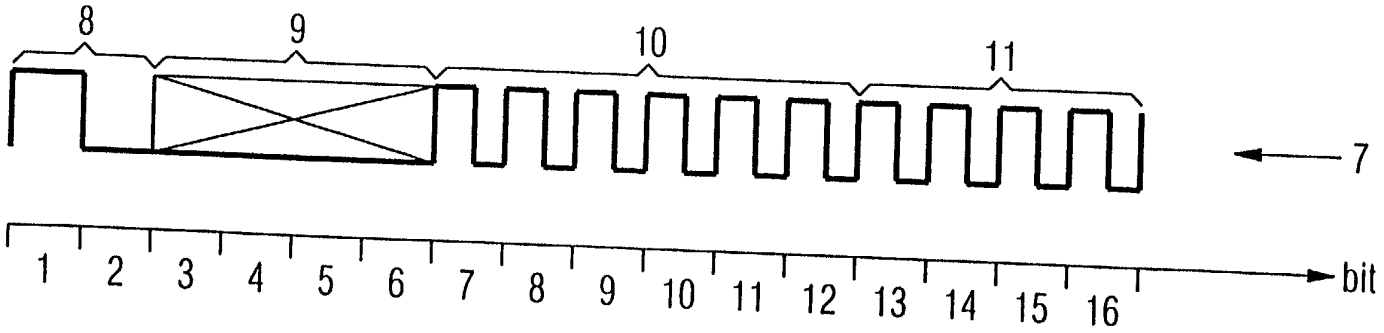


FIG 2



Declaration and Power of Attorney For Patent Application
Erklärung Für Patentanmeldungen Mit Vollmacht
German Language Declaration

Als nachstehend benannter Erfinder erkläre ich hiermit an Eides Statt:

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Datenuebertragungsverfahren und -system, insbesondere in einem Kraftfahrzeug-Insassenschutzsystem

deren Beschreibung

(zutreffendes ankreuzen)
☐ hier beigefügt ist.
☒ am 01.03.2000 als
PCT internationale Anmeldung
PCT Anmeldungsnummer PCT/DE00/00619
eingereicht wurde und am _____
abgeändert wurde (falls tatsächlich abgeändert).

Ich bestätige hiermit, dass ich den Inhalt der obigen Patentanmeldung einschliesslich der Ansprüche durchgesehen und verstanden habe, die eventuell durch einen Zusatzantrag wie oben erwähnt abgeändert wurde.

Ich erkenne meine Pflicht zur Offenbarung irgendwelcher Informationen, die für die Prüfung der vorliegenden Anmeldung in Einklang mit Absatz 37, Bundesgesetzbuch, Paragraph 1.56(a) von Wichtigkeit sind, an.

Ich beanspruche hiermit ausländische Prioritätsvorteile gemäss Abschnitt 35 der Zivilprozessordnung der Vereinigten Staaten, Paragraph 119 aller unten angegebenen Auslandsanmeldungen für ein Patent oder eine Erfindersurkunde, und habe auch alle Auslandsanmeldungen für ein Patent oder eine Erfindersurkunde nachstehend gekennzeichnet, die ein Anmeldedatum haben, das vor dem Anmeldedatum der Anmeldung liegt, für die Priorität beansprucht wird.

As a below named inventor, I hereby declare that:

My residence, post office address and citizenship are as stated below next to my name,

I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled

Method and system for data transmission, notably in a motor vehicle occupant protection system

the specification of which

(check one)
☐ is attached hereto.
☒ was filed on 01.03.2000 as
PCT international application
PCT Application No. PCT/DE00/00619
and was amended on _____
(if applicable)

I hereby state that I have reviewed and understand the contents of the above identified specification, including the claims as amended by any amendment referred to above.

I acknowledge the duty to disclose information which is material to the examination of this application in accordance with Title 37, Code of Federal Regulations, §1.56(a).

I hereby claim foreign priority benefits under Title 35, United States Code, §119 of any foreign application(s) for patent or inventor's certificate listed below and have also identified below any foreign application for patent or inventor's certificate having a filing date before that of the application on which priority is claimed:

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Prior foreign appplications
Priorität beansprucht

			Priority Claimed	
19909535.3	DE	04.03.1999	☒	☐
(Number)	(Country)	(Day Month Year Filed)	Yes	No
(Nummer)	(Land)	(Tag Monat Jahr eingereicht)	Ja	Nein
			☐	☐
(Number)	(Country)	(Day Month Year Filed)	Yes	No
(Nummer)	(Land)	(Tag Monat Jahr eingereicht)	Ja	Nein
			☐	☐
(Number)	(Country)	(Day Month Year Filed)	Yes	No
(Nummer)	(Land)	(Tag Monat Jahr eingereicht)	Ja	Nein

Ich beanspruche hiermit gemäss Absatz 35 der Zivilprozessordnung der Vereinigten Staaten, Paragraph 120, den Vorzug aller unten aufgeführten Anmeldungen und falls der Gegenstand aus jedem Anspruch dieser Anmeldung nicht in einer früheren amerikanischen Patentanmeldung laut dem ersten Paragraphen des Absatzes 35 der Zivilprozeßordnung der Vereinigten Staaten, Paragraph 122 offenbart ist, erkenne ich gemäss Absatz 37, Bundesgesetzbuch, Paragraph 1.56(a) meine Pflicht zur Offenbarung von Informationen an, die zwischen dem Anmeldedatum der früheren Anmeldung und dem nationalen oder PCT internationalen Anmeldedatum dieser Anmeldung bekannt geworden sind.

I hereby claim the benefit under Title 35. United States Code. §120 of any United States application(s) listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States application in the manner provided by the first paragraph of Title 35, United States Code, §122, I acknowledge the duty to disclose material information as defined in Title 37, Code of Federal Regulations, §1.56(a) which occured between the filing date of the prior application and the national or PCT international filing date of this application.

PCT/DE00/00619	01.03.2000	anhängig	pending
(Application Serial No.) (Anmeldeseriennummer)	(Filing Date D, M, Y) (Anmeldedatum T, M, J)	(Status) (patentiert, anhängig, aufgegeben)	(Status) (patented, pending, abandoned)
(Application Serial No.) (Anmeldeseriennummer)	(Filing Date D,M,Y) (Anmeldedatum T, M; J)	(Status) (patentiert, anhängig, aufgeben)	(Status) (patented, pending, abandoned)

Ich erkläre hiermit, dass alle von mir in der vorliegenden Erklärung gemachten Angaben nach meinem besten Wissen und Gewissen der vollen Wahrheit entsprechen, und dass ich diese eidesstattliche Erklärung in Kenntnis dessen abgebe, dass wissentlich und vorsätzlich falsche Angaben gemäss Paragraph 1001, Absatz 18 der Zivilprozessordnung der Vereinigten Staaten von Amerika mit Geldstrafe belegt und/oder Gefängnis bestraft werden koennen, und dass derartig wissentlich und vorsätzlich falsche Angaben die Gültigkeit der vorliegenden Patentanmeldung oder eines darauf erteilten Patentes gefährden können.

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